

**TICKS (ACARI: ARGASIDAE AND IXODIDAE) FROM
THE CALIFORNIA CHANNEL ISLANDS**

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The tick fauna of the California Channel Islands, a group of 8 islands lying 20 to 98 km off the coast of southern California (Philbrick, 1967), has been little studied. Of the 20 species of argasid and 31 species of ixodid ticks known from California (D. P. Furman, pers. comm.), only 1 argasid, *Ornithodoros talaje* (Guérin-Méneville), and 3 ixodids, *Ixodes peromysci* Augustson, *I. pacificus* Cooley and Kohls, and *I. signatus* Birula reportedly occur there (Banks, 1908; Augustson, 1939; Cooley and Kohls, 1945; Miller and Menke, 1981; Schwan and Kelly, 1981). The record of *O. talaje* from San Clemente Island (Banks, 1908) is of doubtful validity, however.

Heretofore the only Channel Islands survey of significant numbers of vertebrates for ectoparasites was that of the Los Angeles Museum-Channel Islands Biological Survey from 1939 to 1941. Ticks collected during that survey were partially reported on by Augustson (1939) and Cooley and Kohls (1945), and recently studied by D. P. Furman and E. C. Loomis, University of California, who are preparing a bulletin on ticks of California.

From 1975 to 1979, personnel (P. W. Collins, S. E. Miller, J. Storrer, K. W. Rindlaub, J. M. Greaves, L. Laughrin, and F. G. Hochberg) of the Santa Barbara Museum of Natural History (SBMNH) made a survey of certain mammals and their ectoparasites on the following islands: East, Middle, and West Anacapa (Ventura County), San Miguel, Santa Barbara, Santa Cruz, and Santa Rosa (all Santa Barbara County). Coincidentally, lizards were captured and their ectoparasites also removed. Two of the several species of ticks found during this study were previously unrecorded from any of the islands. The purpose of this report is to document the geographical, host, and temporal distributions of these ticks.

Materials and Methods

Study area.—The California Channel Islands comprise 2 groups of 4 major islands each as follows: the Northern Channel Islands made up of San Miguel, Santa Rosa, Santa Cruz, and Anacapa; and the Southern Channel Islands composed of Santa Barbara, San Nicolas, Santa Catalina, and San Clemente. The islands range in total land area from 2.6 km² for Santa Barbara to 249 km² for Santa Cruz (Philbrick, 1967). Coastal sage scrub is the predominant vegetational type; chaparral and oak woodland also occur on the largest islands (Savage, 1967). Temperatures are milder and climate moister than the adjacent mainland areas.

Thirty-four species of modern land mammals have been recorded on the islands, 14 of which are native to California, including a single species, *Urocyon littoralis* (Baird), endemic to the islands (von Bloeker, 1967; Johnson, 1978). Man and 19 species deliberately or accidentally introduced by him constitute the remainder. The herpetofauna consists of 3 species of salamanders, 1 species of frog, 5 species of lizards, and 7 species of snakes (Savage, 1967).

Mammalian and reptilian collections.—Approximately 585 deer mice, *Peromyscus maniculatus* (Wagner) ssp. were captured with Museum Special snap traps (baited with rolled oats and peanut butter) on Anacapa, San Miguel, and Santa Barbara Islands, and 1013 *P. maniculatus elusus* Nelson and Goldman were taken with Sherman live traps (baited with rolled oats) on Santa Barbara Island, examined, and then released. Sherman traps were set overnight in lines of 60 each. Black rats, *Rattus rattus* (Linnaeus), were collected with Victor rat traps (baited with rolled oats and peanut butter) on Anacapa and San Miguel Islands. One hundred island gray foxes, *U. l. littoralis*, were live-trapped on San Miguel Island, and 15 *U. littoralis* ssp. found dead on various islands also were inspected. European rabbits, *Oryctolagus cuniculus* (Linnaeus), and Canadian elk, *Cervus canadensis* Erxleben, were taken by shooting on Santa Barbara and Santa Rosa Islands, respectively. Southern alligator lizards, *Gerrhonotus multicarinatus* (Blainville), were collected on Anacapa, San Miguel, and Santa Rosa Islands. In 1980, after the present survey had been completed, a spotted skunk, *Spilogale gracilis amphialus* Dickey, found dead on Santa Cruz Island, was also examined for ectoparasites.

Ticks were removed with forceps from live-trapped animals in the field or from frozen specimens in the laboratory. Occasionally, collections from 2 or more individuals of the same mammalian species captured within the same trapline were pooled. All ticks were preserved in 70% ethanol prior to identification. Larval ticks were usually mounted in Berlese or Hoyer's media on micro slides and examined with a compound microscope, whereas

unmounted nymphal and adult ticks were inspected with a dissecting microscope. All material has been deposited in the SBMNH except for 2 larvae and 4 nymphs of *I. peromysci* that were placed in the tick collection of the Rocky Mountain Laboratories, Hamilton, Montana.

Results

As summarized in Table 1, a total of 1934 mammals representing 7 species, and 32 alligator lizards, yielded 28 collections of ticks of 5 species (1 argasid, 4 ixodids). In addition, 117 *P. maniculatus streator* Nelson and Goldman from San Miguel and 9 *U. littoralis* spp. from various islands were examined for ticks with negative results. Only 11 (0.7%) of 1599 deer mice, *P. maniculatus* spp., 3 (2.6%) of 115 island foxes, *U. littoralis* spp., and 5 (1.6%) of 322 black rats, *R. rattus*, had ticks. However, field examination of live mammals may have missed some small ticks. *Ixodes pacificus* and *I. peromysci* exhibited the broadest host ranges by occurring on 3 species; the remaining ticks were each collected from 1 or 2 host species.

The records of *Otobius megnini* (Dugès) from Santa Rosa, *Haemaphysalis leporispalustris* (Packard) from Santa Barbara, *I. pacificus* from San Miguel and Santa Rosa, *I. peromysci* from West Anacapa, and *I. rugosus* Bishopp from Santa Cruz constitute new distributional records for these ticks. New host records include *I. pacificus* from *U. l. littoralis*, *I. peromysci* from *G. multicaudatus*, *P. maniculatus anacapae* von Bloeker, and *R. rattus*, and *I. rugosus* from *U. littoralis santacruzae* Merriam and *S. gracilis amphialus*. The collection of *I. peromysci* from *G. multicaudatus* also represents the first record of this tick from a reptile.

Immatures of *I. peromysci* were found on animals predominantly in October with 2 records in March, whereas most adults of this tick were collected during March with isolated records in June and October (Table 1). Collection records for the other ticks are too scanty to warrant discussion of their seasonal distributions.

Discussion

The ear tick, *O. megnini*, is widely distributed in warmer regions of the United States and appears to be common in parts of southern California (Cooley and Kohls, 1944). Ten of 11 Californian collection records published by Cooley and Kohls (1944) were based upon material collected in southern California, and all collections were taken from cattle. Although *O. megnini* has been found on elk before (e.g., Bishopp and Trembley, 1945; Rich, 1957), this is apparently the first published report of its occurrence on elk in this state. Elk were unsuccessfully introduced onto Santa Rosa Island in 1905. A second introduction in 1930 involving approximately 15 animals from Yellowstone National Park, Wyoming, resulted in the present population. *O. megnini* may have been brought to Santa Rosa Island directly on

Table 1. Records of argasid and ixodid ticks collected from the California Channel Islands, 1975–1980.

	Number				Host (no. infested/ no. examined)	Locality ¹	Collector	Date
	L	N	♂	♀				
Argasidae								
<i>Otobius megnini</i>	0	10	0	0	<i>Cervus canadensis</i> (1/2)	Upper Windmill Canyon, Santa Rosa I.	S. Miller	21.IV.1976
Ixodidae								
<i>Haemaphysalis leporispalustris</i>	0	0	1	1	<i>Oryctolagus cuniculus</i> (1/20)	NE Signal Peak, Santa Barbara I.	P. Collins	6.III.1979
<i>Ixodes pacificus</i>	0	3	0	0	<i>Gerrhonotus multicarinatus</i> (4/ 25) ²	SBMNH Nos. 301–302, Johnson's Lee, Santa Rosa I.	P. Collins	13.V.1975
	0	1	0	0	<i>Gerrhonotus multicarinatus</i> (4/ 25) ²	SBMNH No. 360, Windmill Canyon, Santa Rosa I.	P. Collins	27.V.1976
	1	0	0	0	<i>Gerrhonotus multicarinatus</i> (4/ 25) ²	SBMNH No. 426, mouth of Old Ranch Canyon, Santa Rosa I.	P. Collins	11.V.1978
	0	1	0	0	<i>Gerrhonotus multicarinatus</i> (4/ 25) ²	Canada do Mar, San Miguel I.	P. Collins	27.IV.1979
	0	0	3	3	<i>Urocyon l. littoralis</i> (2/100)	San Miguel I.	L. Laughrin	10.II.1979
	0	0	1	2	<i>U. l. littoralis</i> (2/100)	San Miguel I.	L. Laughrin	10.II.1979
	0	0	0	1	<i>Homo sapiens</i> (1/1)	Nidever Canyon, San Miguel I.	P. Collins	25.IV.1979

Table 1. Continued

	Number				Host (no. infested/ no. examined)	Locality ¹	Collector	Date
	L	N	♂	♀				
<i>Ixodes peromysci</i>	0	1	0	0	<i>G. multica rinatus</i> (1/ 7) ²	SBMNH No. 488, Oak Canyon, West Anacapa I.	D. Johnson, S. Miller	I.X.1978
	2	2	0	0	<i>Peromyscus maniculatus anacapae</i> (4/196) ³	SBMNH No. 104, West Anacapa I.	P. Collins, S. Miller	1.X.1978
	2	1	0	0	<i>Peromyscus maniculatus anacapae</i> (4/196) ³	SBMNH No. 110, West Anacapa I.	P. Collins, S. Miller	2.X.1978
	0	1	0	0	<i>Peromyscus maniculatus anacapae</i> (4/196) ³	SBMNH No. 110, West Anacapa I.	P. Collins, S. Miller	3.X.1978
	0	0	0	1	<i>Peromyscus maniculatus anacapae</i> (4/196) ³	SBMNH No. 110, West Anacapa I.	J. Greaves	3.X.1978
	0	0	0	3	<i>P. maniculatus elusus</i> (7/1286)	Santa Barbara I.	J. Storrer, J. Trager	12.VI.1978
	0	1	0	0	<i>P. maniculatus elusus</i> (7/1286)	SBMNH Nos. 74-75, Santa Barbara I.	J. Storrer	6.III.1979
	0	1	0	0	<i>P. maniculatus elusus</i> (7/1286)	SBMNH Nos. 74-75, Santa Barbara I.	P. Collins	7.III.1979
	0	0	0	1	<i>P. maniculatus elusus</i> (7/1286)	SBMNH No. 76, Santa Barbara I.	P. Collins	8.III.1979
	0	0	1	1	<i>P. maniculatus elusus</i> (7/1286)	SBMNH No. 75, Santa Barbara I.	J. Storrer	8.III.1979

Table 1. Continued

	Number				Host (no. infested/ no. examined)	Locality ¹	Collector	Date
	L	N	♂	♀				
	0	0	0	1	<i>P. maniculatus</i> <i>elusus</i> (7/1286)	SBMNH No. 75, Santa Barbara I.	J. Storrer	8.III.1979
	0	0	1	3	<i>P. maniculatus</i> <i>elusus</i> (7/1286)	SBMNH No. 76, Santa Barbara I.	P. Collins, S. Miller	9.III.1979
	0	1	0	0	<i>Rattus rattus</i> (5/322) ⁴	SBMNH No. 105, West Anacapa I.	P. Collins, S. Miller	1.X.1978
	0	1	0	0	<i>Rattus rattus</i> (5/322) ⁴	West Anacapa I.	P. Collins	1.X.1978
	4	13	0	0	<i>Rattus rattus</i> (5/322) ⁴	SBMNH No. 107, West Anacapa I.	P. Collins, S. Miller	2.X.1978
	0	1	0	0	<i>Rattus rattus</i> (5/322) ⁴	SBMNH No. 105, West Anacapa I.	P. Collins, S. Miller	3.X.1978
	6	2	0	0	<i>Rattus rattus</i> (5/322) ⁴	SBMNH No. 106, West Anacapa I.	P. Collins, S. Miller	3.X.1978
<i>Ixodes rugosus</i>	0	0	0	1	<i>U. littoralis</i> <i>santacruzae</i> (1/6)	Main ranch (Stanton property), Santa Cruz I.	L. Laughrin	3.IV.1978
	0	0	0	1	<i>Spilogale gracilis</i> <i>amphialus</i> (1/1)	Nr. Bosque Cabrillo, Santa Cruz I.	P. Schuyler	22.XI.1980

¹ SBMNH numbers refer either to herpetology specimen numbers or mammalian census station (=trapline) numbers.

² Fourteen alligator lizards were collected from Santa Rosa, 11 from San Miguel, and 7 from Anacapa Islands.

³ Of this total, 96 deer mice were examined from West Anacapa, 99 from Middle Anacapa, and 1 from East Anacapa Islands.

⁴ In total, 283 specimens were examined from East, Middle, and West Anacapa Islands, and 39 from San Miguel Island.

elk or it may have been transported there on cattle from the mainland and subsequently transferred to elk by mutual grazing of both hosts on the same rangelands. Cattle have been present on Santa Rosa Island since about 1902 and, recently, the owners of Santa Rosa Island have had trouble with ticks on cattle.

Ixodes peromysci is 1 of only 2 *Ixodes* species (out of a total of 36 species) from the U.S.A. that has a strictly insular distribution (Keirans and Clifford, 1978). Previously it had been found solely on deer mice, *P. maniculatus elusus*, from Santa Barbara Island, Santa Barbara County (not Los Angeles County), the type locality, and on *P. maniculatus clementis* Mearns from San Clemente Island, Los Angeles County, California. Thus, the host records from *P. maniculatus anacapae*, *R. rattus*, and *G. multicastratus* are new for this tick. None of the other 19 species of *Ixodes* recorded from California, except for *I. pacificus*, is known to use reptiles as hosts for its immatures. The collections from West Anacapa Island extend the known distribution of *I. peromysci* approximately 69 km NNW of its former northernmost distribution.

The low infestation levels recorded for each of the 4 host species and subspecies of *I. peromysci*, especially the rodents, probably are underestimates because most of the black rats and some of the deer mice were snap-trapped, frozen, and subsequently examined, and some live-trapped deer mice were examined cursorily and then released. As noted by Westrom and Yescott (1975), the vagility of ectoparasites interferes with attempts to accurately estimate their abundance, particularly when an exodus from dead hosts occurs prior to collection attempts. These investigators showed that fleas, chiggers, and mesostigmatid mites began leaving California ground squirrels, *Spermophilus beecheyi* (Richardson), within 45 minutes post mortem in contradistinction to lice, which remained on the host for approximately 5 hours before leaving. Unfortunately, ticks were not found on any of the animals they inspected.

The rabbit tick, *Haemaphysalis leporispalustris*, has been recorded from Alaska, Canada, all the U.S.A., and southward to Argentina. A single specimen was collected from the ear of a "rabbit" on East Anacapa Island, 26 August 1940, by G. P. Kanakoff during the 1939–1941 Channel Islands Biological Survey (unpublished determination by G. F. Augustson recently confirmed by D. P. Furman and associates). The European rabbit, *Oryctolagus cuniculus*, the only lagomorph documented from East Anacapa Island (not *Lepus europaeus* Pallas as stated by von Bloeker, 1967), has been extirpated from there since the mid-1960's (Banks, 1966). On Santa Barbara Island, 1 of 20 *O. cuniculus* inspected in this study was parasitized by *H. leporispalustris*, which is considerably lower than the frequency per host reported for this tick on native lagomorphs (i.e., *Lepus californicus* Gray and *Sylvilagus bachmani* (Waterhouse)) from the Californian mainland

(Coultrip et al., 1973; Lane et al., 1981). In the U.S.A., important hosts of the rabbit tick include a number of species and subspecies of *Lepus* (hares) and *Sylvilagus* (rabbits) as well as a variety of birds, small mammals, and other hosts (Cooley, 1946).

In western U.S.A., *I. pacificus*, a vicious man-biter, reportedly occurs from California to Washington and in Nevada, Utah, and Idaho (Keirans and Clifford, 1978). The only published record of it from the Channel Islands was that of a nymph taken from a California Quail, *Lophortyx californica catalinensis* Grinnell, on Santa Catalina Island, 23 January 1941 (Cooley and Kohls, 1945). Although *I. pacificus* has not been recorded hitherto from island foxes, it has been found before on *Urocyon* sp. in California (Arthur and Snow, 1968). At least 53 additional species of vertebrates including man and many other mammals, 5 species of birds, and possibly 9 species of lizards have been reported as hosts for *I. pacificus* on the mainland. In California, this tick commonly attacks man and has been incriminated in several mild cases of paralysis in children (Herms, 1950) and in a single human case of erythema chronicum migrans (Naversen and Gardner, 1978).

Finally, in the U.S.A., *I. rugosus* parasitizes skunks, foxes, weasels, and domestic dogs from California to Washington (Keirans and Clifford, 1978). The only spotted skunk examined from Santa Cruz Island yielded a female *I. rugosus*, and island foxes found dead there had an infestation rate of 0.17 *I. rugosus* ticks per host ($n = 6$). Although none of 100 island foxes from San Miguel yielded *I. rugosus*, it cannot be assumed that this tick does not parasitize foxes there because tick infestation rates found in this study were generally quite low.

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